Automata Theory - Midterm

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1 Instructions

1. Attempt as many problems as you can. You will be given partial credit.

2 Problems

1. Consider the $\epsilon - NFA$ defined below:

	ϵ	a	b	c
$\rightarrow p$	ϕ	$\{p\}$	$\{q\}$	$\{r\}$
q	$\{p\}$	$\{q\}$	$\{r\}$	ϕ
$*r$	$\{q\}$	$\{r\}$	ϕ	$\{p\}$

   (a) Compute the ϵ-closure of each state. (3 points)

   (b) Convert the automaton to a DFA. (4 points)

2. Let $\Sigma = \{a, b, c\}$. Write a regular expression for the language consisting of the set of strings containing at least one a and at least one b. (4 points)

3. Let $\Sigma = \{0, 1\}$. Which of the following languages is regular? Provide an explanation in each case. (6 points)

   (a) $L = \{0^n 1^m | \ n \leq m, \ n, m \geq 0\}$

   (b) $L = \{0^n 1^m | \ n \geq m, \ n, m \geq 0\}$

   (c) $L = \{0^n 1^m | \ n, m \geq 0\}$

4. Let $\Sigma = \{0, 1\}$. Let L be the language that consists of strings having either 01 repeated one or more times *or* 010 repeated one or more times. Is L regular? Explain. (4 points)

5. Assume that a regular language L is provided to you as a DFA $\mathbf{A} =< Q, \Sigma, \delta, q_0, F >$. How would you check whether L is infinite? (5 points).
   Hint: Pumping Lemma.

6. Let $\Sigma = \{0, 1\}$. We showed in class that the language $L = \{0^n 1^n | \ n \geq 0\}$ is not regular. Argue using closure properties of regularity, that $L' = \{0^i 1^j | \ i \neq j\}$ is not regular. (4 points)